(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 969 630 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.01.2000 Bulletin 2000/01

(51) Int. Cl.[7]: **H04L 12/56**

(21) Application number: **99112610.3**

(22) Date of filing: **01.07.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **01.07.1998 JP 18592198**

(71) Applicant: **Hitachi, Ltd.**
Chiyoda-ku, Tokyo 101-8010 (JP)

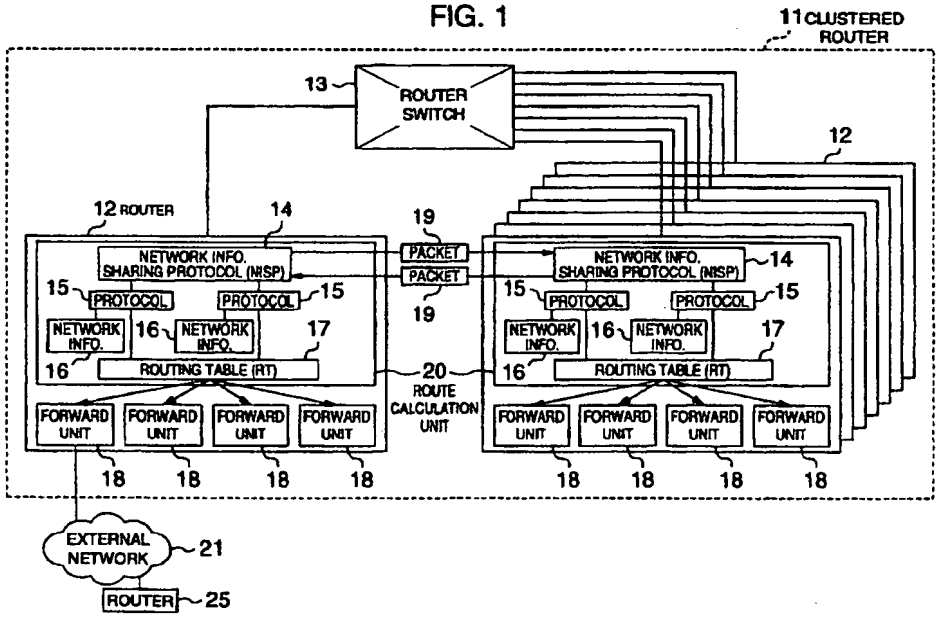
(72) Inventors:
- **Tsukakoshi, Masato**
  Sagamihara-shi (JP)
- **Suzuki, Shinsuke**
  Fujisawa-shi (JP)
- **Morimoto, Shigeki**
  Atsugi-shi (JP)

(74) Representative:
Strehl Schübel-Hopf & Partner
Maximilianstrasse 54
80538 München (DE)

(54) Method for sharing network information and router apparatus

(57) A highly-expandable router configuration technology which flexibly meets the need to increase lines as a network grows. A network information sharing unit (14) is provided in a route calculation unit (20) of each router (12) in a clustered router (11). The network information sharing unit (14) receives an update notification of network information collected by routing protocol units (15) and sends this update information to all other routers in the clustered router (11) as a network information notification packet (19). The network information sharing units (14) in the receiving router notifies the routing protocol units (15) of the contents of the received updated information. The routing protocol unit (15) updates the network information thereof based on the notified contents, thereby allowing the network information obtained from all routers outside the clustered router (11) to be shared and the clustered router (11) to be recognized externally as a single router.

FIG. 1



EP 0 969 630 A1

FIG. 10 is a diagram showing the operation sequence of the NISP Boot function.

FIG. 11 is a diagram showing the operation sequence of the NISP Flash function.

FIG. 12 is a diagram showing the operation sequence of NISP network information notification.

FIG. 13 is a diagram showing the operation sequence of the NISP Flash & Boot function that is performed during re-initialization of the routing protocol means 15.

FIG. 14 is a diagram showing the operation sequence the routing protocol means.

FIG. 15 is a flowchart showing the packet transmission operation of the NISP means.

FIG. 16 is a flowchart showing the packet reception operation of the NISP means.

FIG. 17 is a flowchart showing another operation of the routing protocol means.

FIG. 18 is a diagram showing the functional blocks according to another embodiment of the present invention.

DESCRIPTION OF THE EMBODIMENTS

[0014] An embodiment of the present invention will be described below with reference to the drawings.

[0015] FIG. 1 shows the configuration of a clustered router according to the present invention and the functional blocks of each router constituting the clustered router. A clustered router 11 includes a plurality of routers each connected by a router-to-router switch 13. Each router 12 includes a route calculation unit 20 which generates and distributes a routing table used for forwarding packets and a plurality of forwarding unit 18 each of which forwards packets.

[0016] Within the route calculation unit 20 of each router 12 is provided two or more routing protocol means 15 which execute routing protocols. Each of the routing protocol means 15 sends or receives control packets to or from some other routers 25 on a network 21 outside the clustered router 11 to obtain network information 16. From the obtained network information 16, the routing protocol means 15 executes route calculation processing, generates terminal-to-terminal routing information, and adds this information to a routing table (RT) 17.

[0017] The routing table 17 generated as described above is distributed to the forwarding units 18 within the router 12 to decide whether to forward packets.

[0018] On the other hand, when the routing protocol means 15 updates the network information 16, it requests network information sharing means 14 to send the update information. In the following description, this network information sharing means 14 is described as NISP (Network Information Sharing Protocol) means 14. The NISP means 14 generates a network information notification packet 19 based on the update information and sends it to all other routers in the clustered router 11 through the router-to-router switch 13. This may be done either by sending a plurality of packets each with the destination of each destination router or by sending a single packet with the destination representing all routers. Taking into consideration that the plurality of routing protocol means 15 are running in the route calculation unit 20, the network information notification packet 19 described above has an identifier (routing protocol identifier) thereon indicating which routing protocol means has generated the update information the packet is now carrying.

[0019] The NISP means 14 of the destination router 12 receives the network information notification packet 19. The NISP means 14 checks the routing protocol identifier included in the received packet and sends the update information to the corresponding routing protocol means 15.

[0020] The routing protocol means 15 updates the network information 16 based on the update information sent from the NISP means 14.

[0021] FIG. 2 shows the configuration of the network system using the clustered router 11. The clustered router 11, composed of the routers 12 and the router-to-router switch 13, is connected to communication terminals 26 and routers 25 functioning as network forwarding apparatus. The clustered router 11 appears to the communication terminals 26 and the other routers 25 as if it was a single network forwarding apparatus. The internal configuration of the clustered router 11 in which a plurality of routers 12 are provided is not visible externally. The router 25 sends or receives routing protocol packets to or from the clustered router 11 to obtain network information. The router 25 then generates the routing table of its own from the obtained network information for use in packet forwarding between the communication terminals 26.

[0022] The network information the router 25 receives from the clustered router 11 contains enough information for generating routing information used to send packets via the clustered router 11. Communication between the communication terminals 26 via the clustered router 11 is performed the same way communication between the communication terminals 26 via a single router is performed.

[0023] FIG. 3 is a diagram showing the configuration of the modules of the NISP means 14 and the routing protocol means 15. Each routing protocol means 15 updates the network information 16 by sending and receiving routing protocol packets. The routing protocol means 15 may contain a plurality of modules 22 which update the network information 16. Each of these modules directly starts an acceptance module 31 in the NISP means 14.

[0024] Upon receiving a request from the routing protocol means 15, the acceptance module 31 in the NISP means 14 creates the network information notification packet 19 based on the request information. After that, a sending module 34 is started for sending the network

network information of RIP (Routing Information Protocol), one of routing protocols executed by the routing protocol means 15. The protocol field of the common header section of the NISP for RIP packet contains the value indicating "RIP". The common header section is followed by the NISP-RIP header section and the NISP-RIP data section. The NISP-RIP header section includes the version field indicating the version of NISP for RIP and the No. of data field indicating the number of NISP-RIP data pieces included in the packet. The NISP-RIP data section includes a sequence of data units each composed of the cmd field indicating the type of command, such as "ADD" or "DEL", and network information collected by RIP. The network information collected by RIP includes the network address, the address of a router through which a packet must first arrive to reach the network, and so on.

[0041] FIG. 10 shows the operation sequence of the boot function that is executed when the router 12 is powered on. When the router 12 is powered on (91), a NISP Boot packet 92 is generated during initialization and is sent to all other routers 12. The req-protocol field of this NISP Boot packet 92 contains a value indicating all routing protocols.

[0042] When the NISP means 14 in the receiving router 12 receives this NISP Boot packet 92, it sends a Boot reception notification 93 to all routing protocol means 15 in that router because the req-protocol field contains the value indicating all routing protocols.

[0043] When routing protocol A, one of the routing protocol means 15 in the router 12, receives this Boot reception notification 93, it searches its own network information 16 for the network information other than that obtained through NISP packets, and sends a transmission request 94 to the NISP means 14 with the obtained information as the update information.

[0044] Upon receiving this transmission request 94, the NISP means 14 checks the routing protocol (routing protocol A) executed by the routing protocol means 15 that issued the transmission request 94, generates a network information notification packet 95 (the protocol field of the common header section indicates routing protocol A), and sends the generated network information notification packet 95 to the router 12 from which the NISP Boot packet was issued.

[0045] Upon receiving the network information notification packet 95 for routing protocol A, the NISP means 14 in the router 12, from which the NISP Boot packet was issued, selects the routing protocol means 15 for executing routing protocol A. This is because the protocol field of the common header section of the packet indicates routing protocol A. The NISP means 14 then sends an update information notification 96 to the selected routing protocol means 15.

[0046] When the routing protocol means 15 receives the update information notification 96, it adds this information to its own network information 16.

[0047] FIG. 11 shows the operation sequence of the Flash function that is executed when the router 12 is shut down. When the router 12 is shut down (101), a NISP Flash packet 102 is generated during shutdown and is sent to all other routers 12. The req-protocol field of this NISP Flash packet 102 contains a value indicating all routing protocols.

[0048] Upon receiving this NISP Flash packet 102, the NISP means 14 in the receiving router 12 sends a Flash reception notification 103 to all routing protocol means 15 in that router 12 because the req-protocol field contains the value indicating all routing protocols.

[0049] When routing protocol means 15 in the router 12 receives this Flash reception notification 103, it deletes from its own network information 16 only the information obtained from the NISP means 14 of the router 12 identified by the flash ID of the received packet.

[0050] FIG. 12 shows how the network information 16 collected by the RIP is maintained when the RIP is used by the routing protocol means 15 as the routing protocol. When the network information 16 is added through execution of the RIP (111), the routing protocol means 15 sends a transmission request 112 to the NISP means 14 to send the update information.

[0051] When the NISP means 14 receives the transmission request 112, it generates a network information notification packet for the RIP 113 (the protocol field of the common header section indicates RIP) because the routing protocol executed by the requesting routing protocol means 15 is the RIP. The NISP means 14 then sends this packet to all other routers in the clustered router 11. At this time, the cmd field of the NISP for RIP data section shown in FIG. 9 indicates "ADD".

[0052] Because the protocol field of the common header section of the packet indicates the RIP, the NISP means 14 in the router 12 which has received the network information notification packet for the RIP 113 sends an update information notification 114 only to the routing protocol means 15 which execute the RIP.

[0053] Upon receiving the update information notification 114, the routing protocol means 15 for executing the RIP adds the received information to its own network information 16 because the cmd field of the packet indicates "ADD"

[0054] On the other hand, when network information is deleted from its own network information 16 through execution of the RIP (115), the routing protocol means 15 sends a transmission request 116 to the NISP means 14 to send the update information.

[0055] When the NISP means 14 receives the transmission request 116, it generates a network information notification packet for the RIP 117 because the routing protocol executed by the requesting routing protocol means 15 is the RIP. The NISP means 14 then sends this packet to all other routers 12 in the clustered router 11. At this time, the cmd field of the NISP for RIP data section indicates "DEL".

[0056] Because the protocol field of the common

header indicates Flash (step 223:Yes), the NISP means 14 checks if the req-protocol field contains a value indicating all routing protocols (step 224). If the field contains a value indicating all routing protocols, the NISP means 14 notifies all routing protocol means 15 of Flash (step 226); otherwise, the NISP means 14 notifies the corresponding routing protocol means 15 of Flash (step 225). Then, the NISP means 14 ends the operation.

[0074] If the cmd field of the NISP management header does not indicate Flash (step 223:NO), the NISP means 14 checks if the cmd field indicates Boot (step 227).

[0075] If the cmd field of the NISP management header indicates Boot (step 227:YES), the NISP means 14 checks if the req-protocol field contains a value indicating all routing protocols (step 228). If the req-protocol field contains that value, the NISP means 14 notifies all routing protocol means 15 of Boot (step 230); otherwise, the NISP means 14 notifies the corresponding routing protocol means 15 of Boot (step 229). Then, the NISP means 14 ends the operation.

[0076] If the cmd field of the NISP management header does not indicate Boot (step 227:NO), the NISP means 14 ends the operation.

[0077] FIG. 17 is a flowchart showing the operation executed by the routing protocol means 15 when it receives a notification from the NISP means 14. First, the routing protocol means 15 checks if the notification is an update information notification (step 241). If the notification from the NISP means 14 is an update information notification (step 241:YES), the routing protocol means 15 updates its own network information 16 with the received update information (step 242). If the notification from the NISP means 14 is not an update information notification (step 241:NO), the routing protocol means 15 checks if the notification is a Flash notification (step 243).

[0078] If the notification from the NISP means 14 is a Flash notification (step 243:YES), the routing protocol means 15 deletes all information, received from the NISP means 14 of the router 12 identified by the flash ID field of the NISP Flash packet, from its network information 16 (step 244). If the notification from the NISP means 14 is not a Flash notification (step 243:NO), the routing protocol means 15 checks if the notification is a Boot notification (step 245).

[0079] If the notification from the NISP means 14 is a Boot notification (step 245:YES), the routing protocol means 15 requests the NISP means 14 to transmit all network information other than that obtained through the NISP means 14 to the NISP means 14 of the router 12 identified by the boot ID field of the NISP Boot packet (step 246). Then, the routing protocol means 15 end the operation. If the notification from the NISP means 14 is not a Boot notification (step 245:NO), the routing protocol means 15 end the operation.

[0080] FIG. 18 is a functional block diagram of the second embodiment according to the present invention. The router 12 comprises the plurality of route calculation units 20 each of which generates and distributes the routing table used for packet forwarding and the plurality of forwarding processing units 18 each of which forwards packets. Only one of the plurality of route calculation units 20 is in the active state, and the rest are in the backup state. Though the router 12 is one element of the clustered router 11 in this figure, the present invention is not limited to this configuration. The router may exist alone.

[0081] Within the active-state route calculation unit 20, the routing protocol means 15 is operating. The routing protocol means 15 sends or receives control packets to or from some other router 25 on a network outside the router 12 to obtain the network information 16. From the obtained network information 16, the routing protocol means 15 performs route calculation to generate routing information and adds this information to the routing table 17.

[0082] The routing table 17 thus generated is distributed to the forwarding units 18 in the router 12 to decide whether to forward packets.

[0083] The routing protocol means 15 in the backup-state route calculation unit 20 does not send or receive packets to or from some other router 25, nor does it distribute the routing table 17 to the forwarding unit 18.

[0084] After updating the network information 16, the routing protocol means 15 in the active-state route calculation unit 20 requests the NISP means 14 to send the update information. The NISP means 14 generates the network information notification packet 19 based on this update information and then sends it to all backup-state route calculation units 20. Because there are the plurality of routing protocol means 15 in the route calculation unit 20, the network information notification packet 19 has the identifier (routing protocol identifier) thereon to indicate which routing protocol has generated the update information.

[0085] The NISP means 14 in the backup-state route calculation unit 20 checks the routing protocol identifier in the received packet and passes the update information to the routing protocol means 15 of the corresponding type.

[0086] The routing protocol means 15 in the backup-state route calculation unit 20 updates the network information 16 based on the update information received from the NISP means 14. At this time, the routing protocol means 15 may or may not generate routing information from the updated network information 16. If the routing protocol means 15 does not generate the routing information at this time, it generates new routing information when the corresponding route calculation unit 20 enters the active-state and then creates the routing table 17.

[0087] The operation described above keeps the network information 16 of the backup-state route calculation unit 20 up-to-date. Therefore, when the active-state route calculation unit 20 fails and the backup-state route

tion packet (19) among routing programs of said plurality of routers, said network information notification packet (19) including said network information (16) collected by the routing protocol of the routing protocol programs provided in each of said plurality of routers; and

generating a routing table (17) based on said network information (16) using said routing protocol program, said routing table (17) being used to decide a destination of a packet to be transferred among said communication terminals (26).

5. A router connecting networks to which communication terminals (26) are connected and which allows network information 16 to be shared, said router comprising:

means for forming the network information (16) with a network information notification packet (19) which includes a type of a routing protocol;
means for transferring said network information notification packet (19) among routing protocol programs of one or more other routers; and
means for generating a routing table (17) based on said network information (16) included in said network information notification packet (19) using said routing protocol program, said routing table (17) being used to decide a destination of a packet to be transferred among said communication terminals (26).

6. A clustered router comprising a plurality of routers connecting networks to which communication terminals (26) are connected, each of said plurality of routers comprising:

means for forming the network information (16) with a network information notification packet (19) which includes a type of a routing protocol;
means for transferring said network information notification packet (19) among routing programs of said plurality of routers, said network information notification packet (19) including said network information (16) collected by the routing protocol of the routing protocol program provided in each of said plurality of routers; and
means for generating a routing table (17) based on said network information (16) using said routing protocol program, said routing table (17) being used to decide a destination of a packet to be transferred among said communication terminals (26).

7. A router which has a plurality of route calculation units (20) and which allows network information to be shared, one of said plurality of route calculation units (20) being in active state with the rest in backup state, said router comprising:

means for forming the network information (16) with a network information notification packet (19) which includes a type of a routing protocol;
means for transferring said network information notification packet (19) to routing protocol programs each operating in said route calculation units (20) in backup state with the use of the routing protocol program operating in said route calculation unit (20) in active state; and
means for sending or receiving the network information (16) to or from other routers with the use of said routing protocol program in one of said route calculation units (20) in backup state based on said transferred network information (16) when said route calculation unit (20) in active state fails.

8. A router in which a plurality of routing protocol programs operate and which allows network information (16) to be shared, each of said plurality of routing protocol programs executing a different routing protocol, said router comprising:

means for forming the network information (16) with a network information notification packet (19) which includes a type of the routing protocol;
means for transferring said network information (16) among routing protocol programs of one or more other routers, said network information being collected based on the routing protocol corresponding to each of said routing protocol programs; and
means for receiving said network information (16) collected based on the other routing protocols and sending said network information (16) to an external router.

FIG. 2

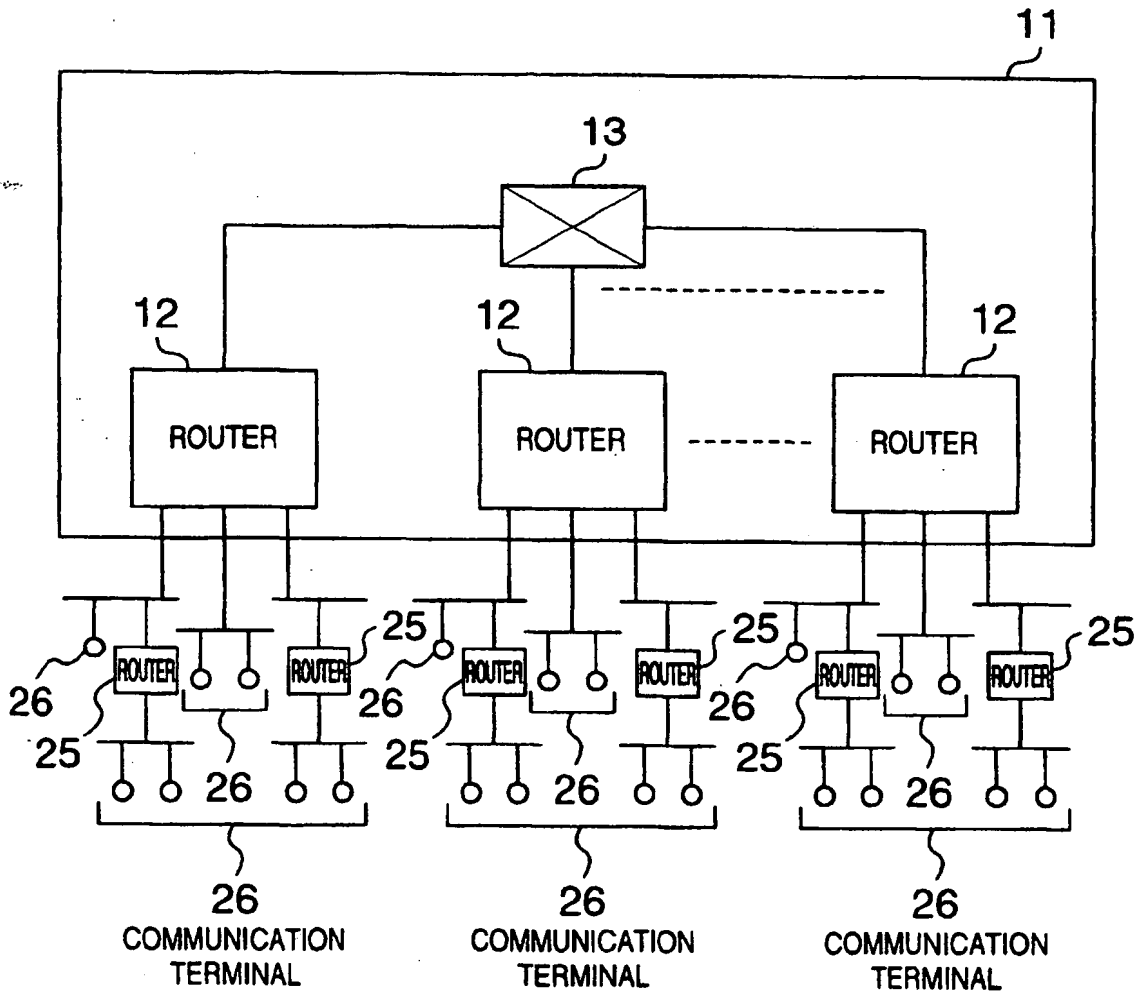

11
13
12
12
12
ROUTER
ROUTER
ROUTER
25
26
COMMUNICATION TERMINAL

FIG. 4

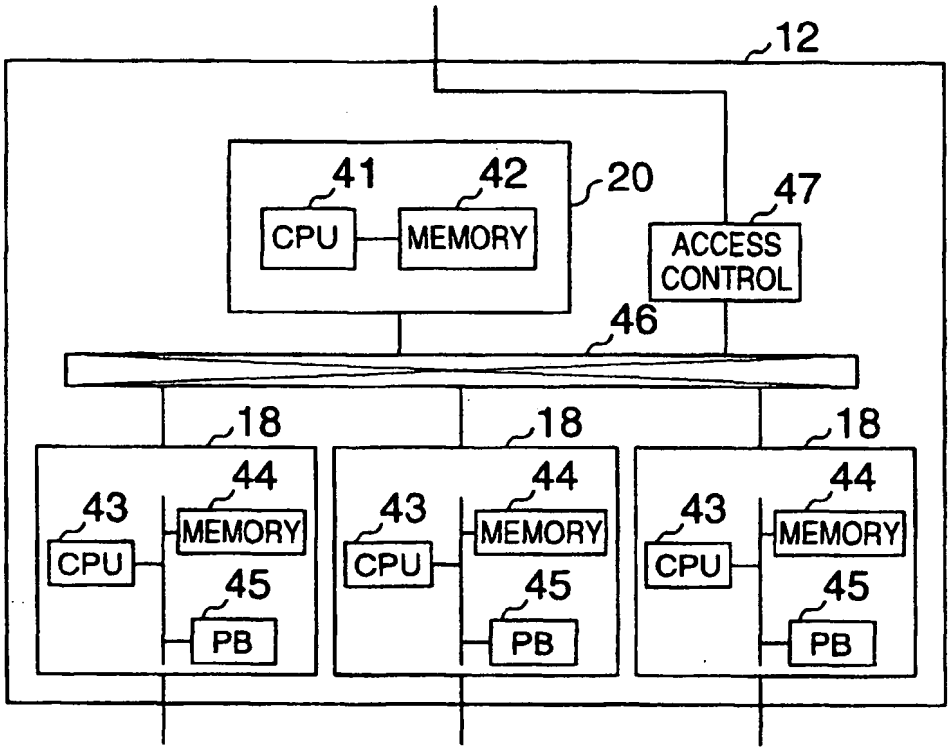


FIG. 5

VERSION	PROTOCOL	COMMON HEADER
RESERVED	SPEAKER ID	
RESERVED	LENGTH	
DATA		

FIG. 9

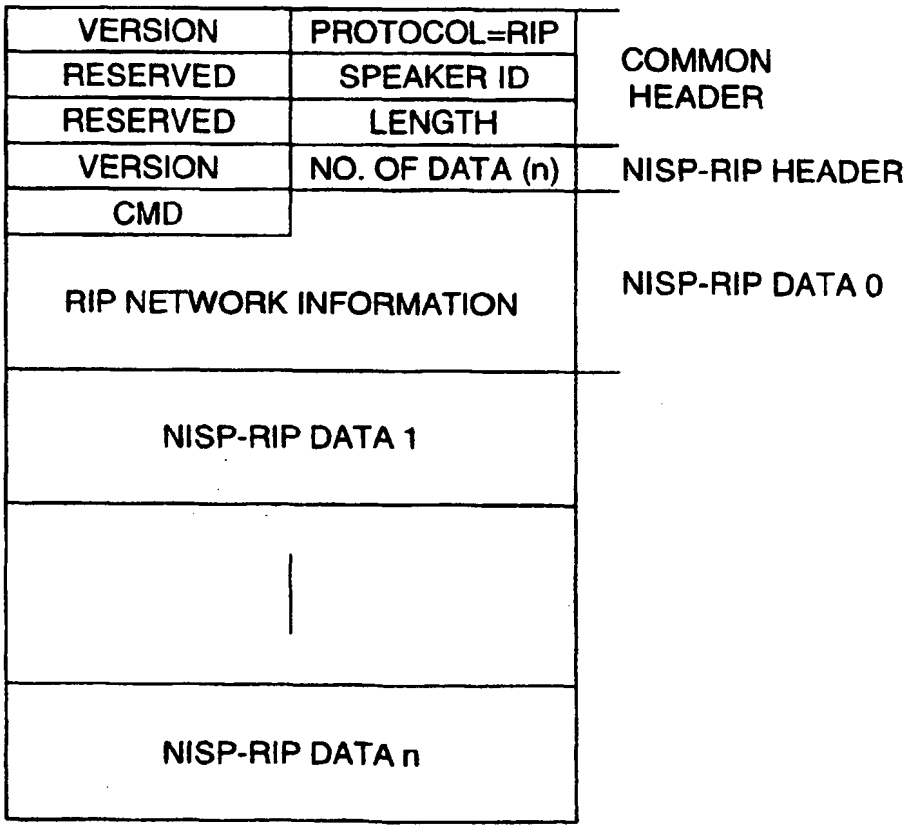

VERSION
PROTOCOL=RIP
RESERVED
SPEAKER ID
RESERVED
LENGTH
COMMON HEADER
VERSION
NO. OF DATA (n)
NISP-RIP HEADER
CMD
RIP NETWORK INFORMATION
NISP-RIP DATA 0
NISP-RIP DATA 1
NISP-RIP DATA n

FIG. 11

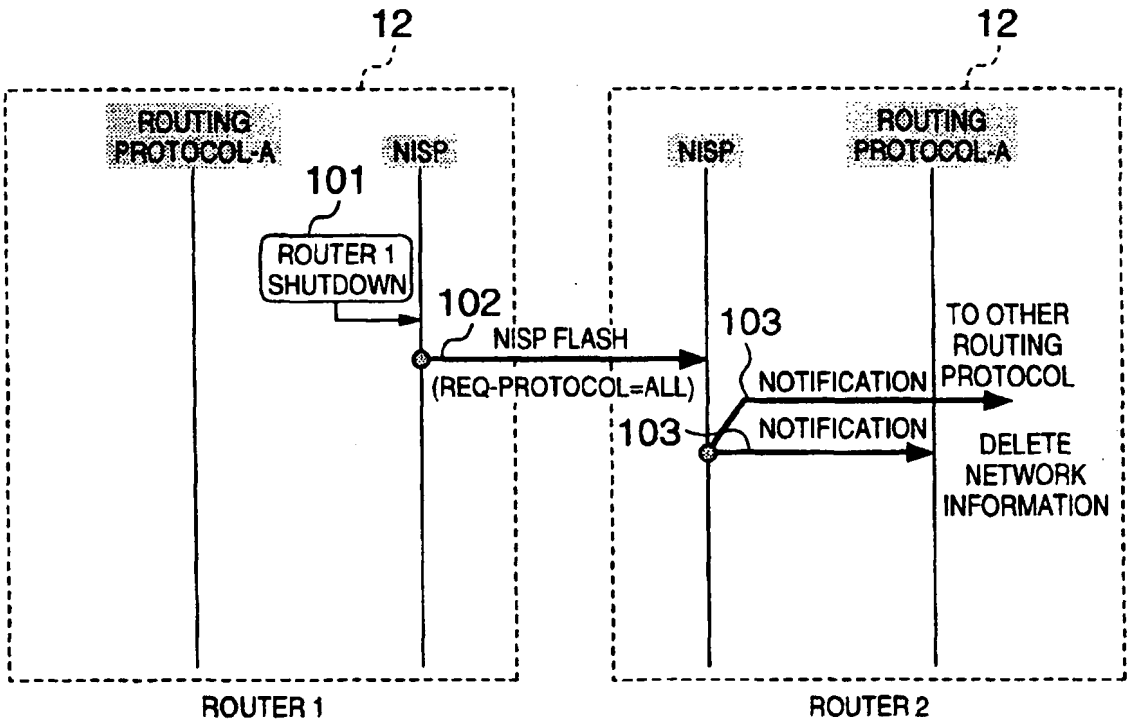

12
12
ROUTING PROTOCOL-A
NISP
NISP
ROUTING PROTOCOL-A
101
ROUTER 1 SHUTDOWN
102
NISP FLASH
(REQ-PROTOCOL=ALL)
103
NOTIFICATION
TO OTHER ROUTING PROTOCOL
103
NOTIFICATION
DELETE NETWORK INFORMATION
ROUTER 1
ROUTER 2

FIG. 13

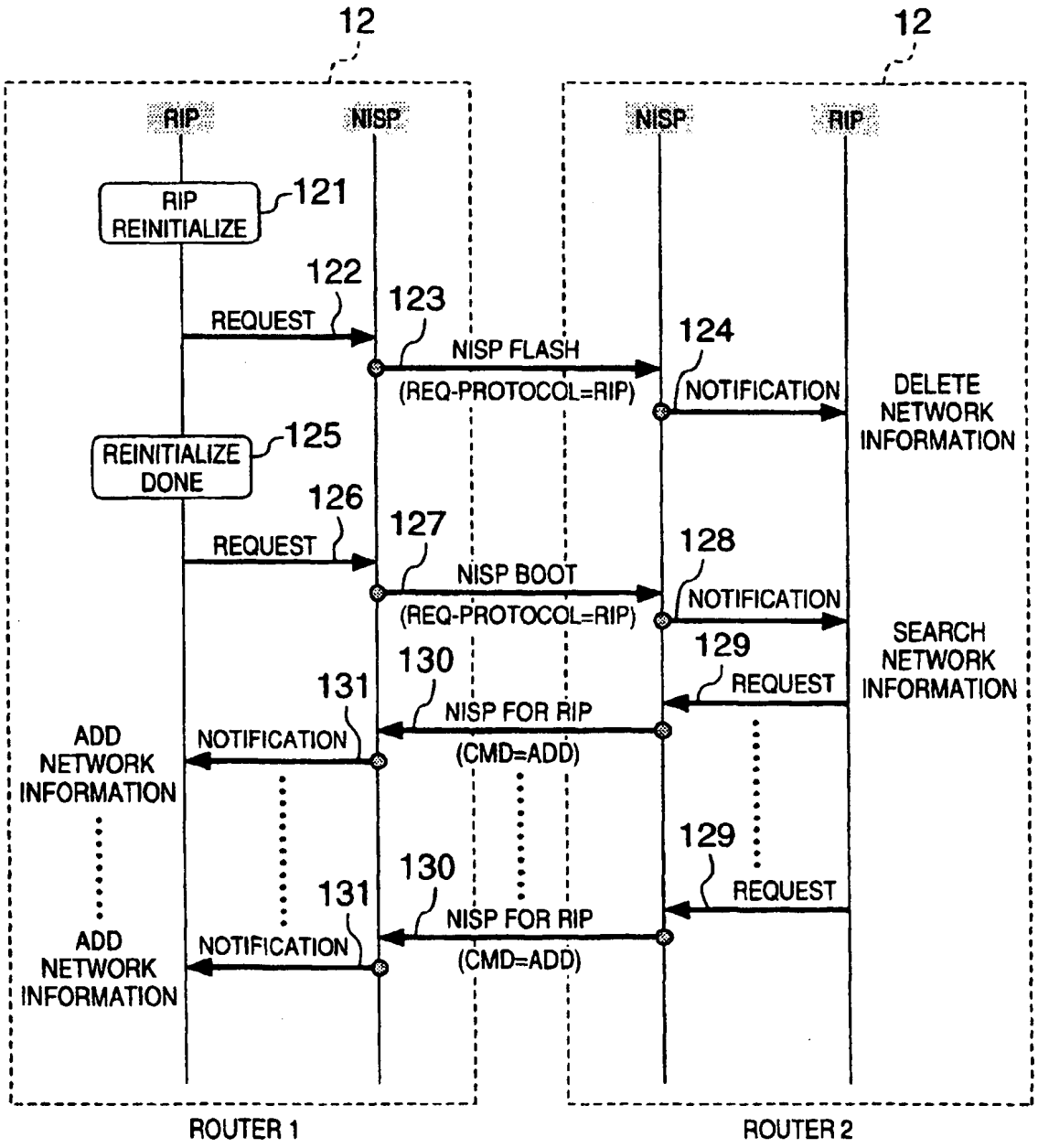

12
12
RIP
NISP
NISP
RIP
RIP REINITIALIZE
121
122
REQUEST
123
NISP FLASH
(REQ-PROTOCOL=RIP)
124
NOTIFICATION
DELETE NETWORK INFORMATION
REINITIALIZE DONE
125
126
REQUEST
127
NISP BOOT
(REQ-PROTOCOL=RIP)
128
NOTIFICATION
129
REQUEST
SEARCH NETWORK INFORMATION
130
NISP FOR RIP
(CMD=ADD)
131
NOTIFICATION
ADD NETWORK INFORMATION
129
REQUEST
130
NISP FOR RIP
(CMD=ADD)
131
NOTIFICATION
ADD NETWORK INFORMATION
ROUTER 1
ROUTER 2

FIG. 16

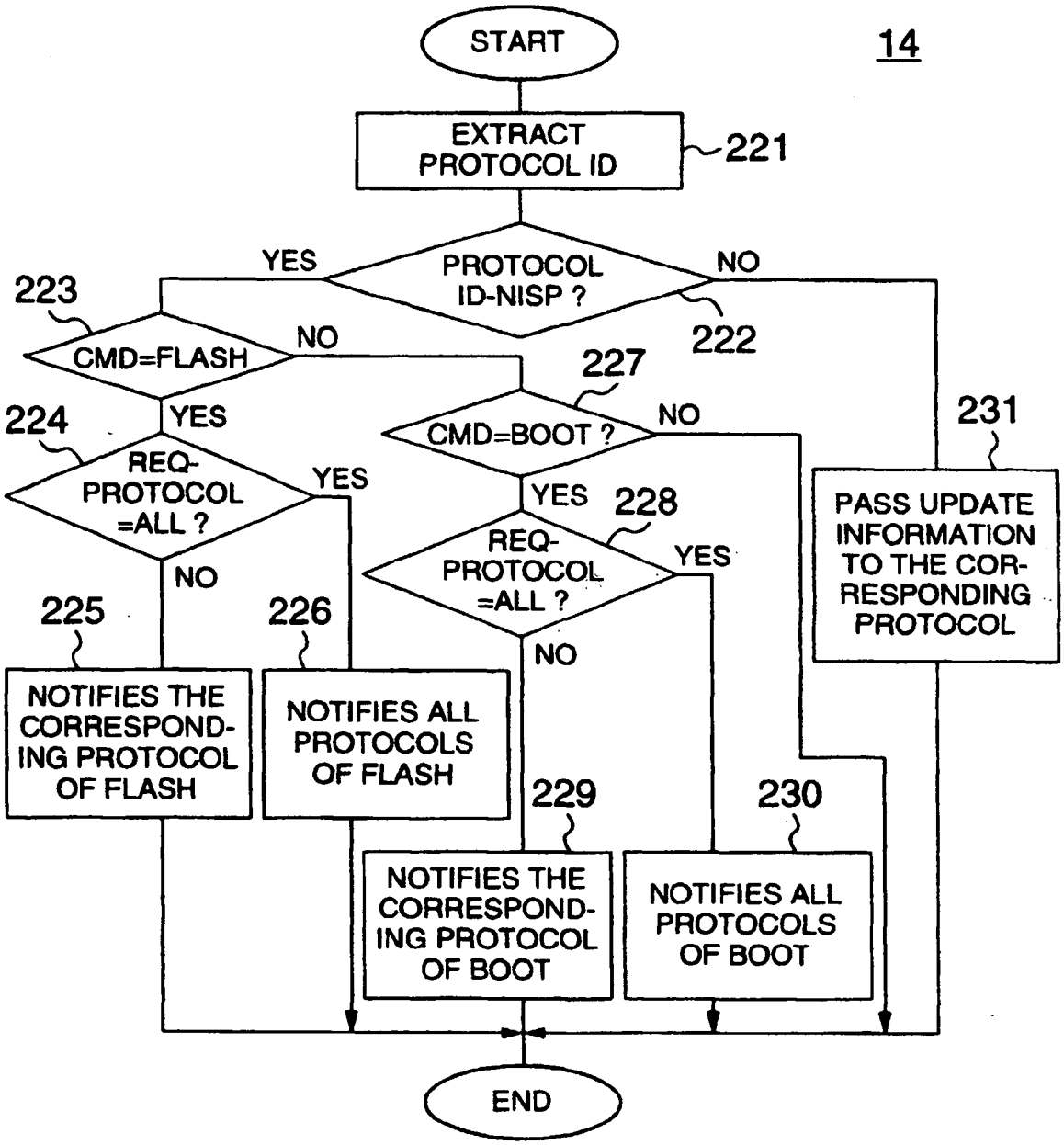
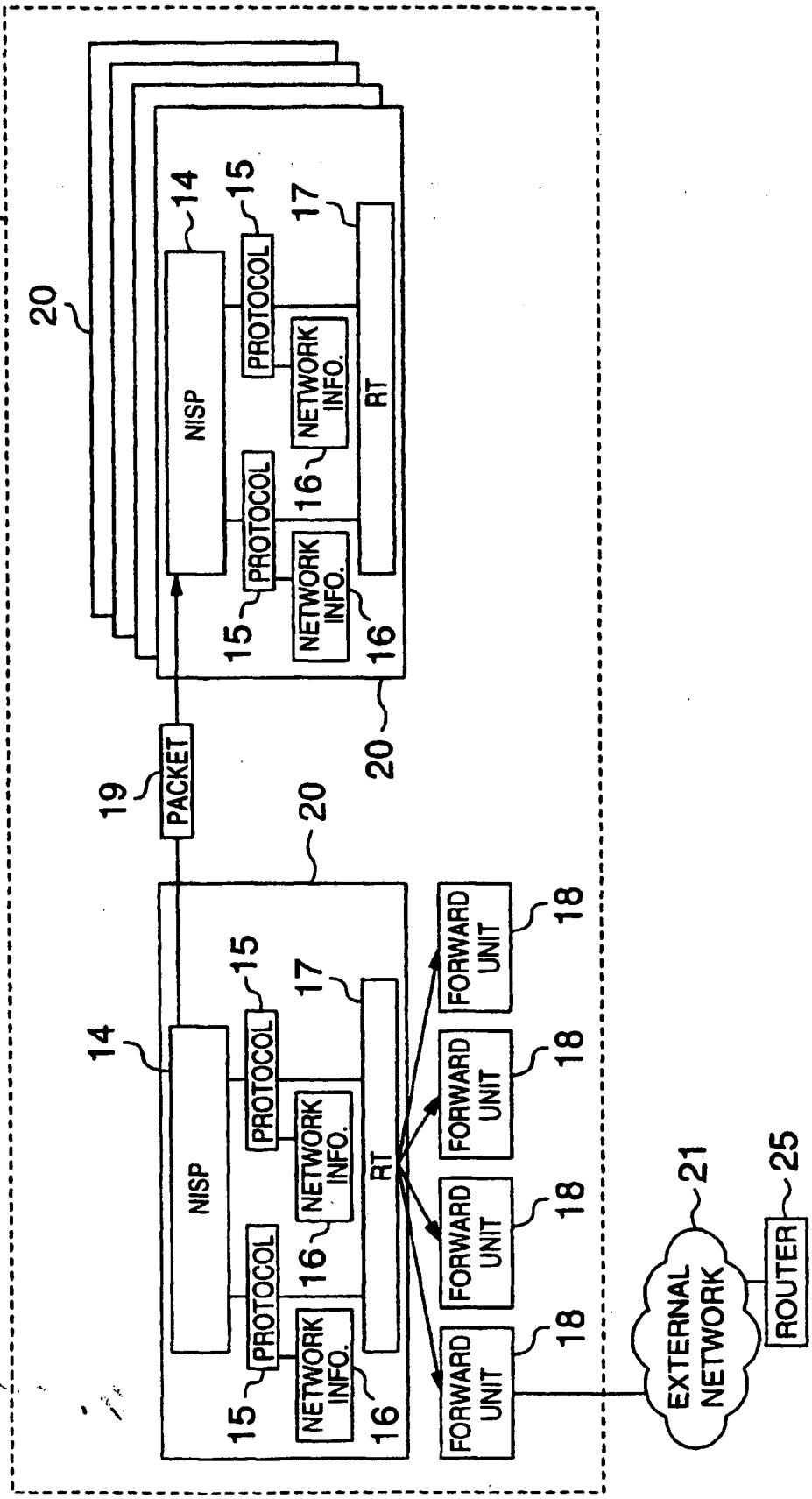

START
14
EXTRACT PROTOCOL ID
221
PROTOCOL ID-NISP ?
YES
NO
222
223
CMD=FLASH
NO
YES
224
REQ-PROTOCOL =ALL ?
YES
NO
225
NOTIFIES THE CORRESPOND-ING PROTOCOL OF FLASH
226
NOTIFIES ALL PROTOCOLS OF FLASH
227
CMD=BOOT ?
NO
YES
228
REQ-PROTOCOL =ALL ?
YES
NO
229
NOTIFIES THE CORRESPOND-ING PROTOCOL OF BOOT
230
NOTIFIES ALL PROTOCOLS OF BOOT
231
PASS UPDATE INFORMATION TO THE COR-RESPONDING PROTOCOL
END

FIG. 18


12
20
NISP
14
PROTOCOL
15
NETWORK INFO.
16
RT
17
19
PACKET
FORWARD UNIT
18
EXTERNAL NETWORK
21
ROUTER
25

2280 HV RIJSWIJK
NETHERLANDS
Tel.: +31 70 340 2040
Fax: +31 70 340 3016

Lang, Johannes
Bardehle Pagenberg Dost Altenburg Geissler,
Postfach 86 06 20
81633 München
ALLEMAGNE

EPO Customer Services
Tel.: +31 (0)70 340 45 00

Date
06.06.07

Reference	Application No./Patent No.
S101353EP	04002060.4 - 1249

Applicant/Proprietor
SAMSUNG ELECTRONICS CO., LTD.

COMMUNICATION

The European Patent Office herewith transmits as an enclosure the European search report (under R. 44 or R. 45 EPC) for the above-mentioned European patent application.

If applicable, copies of the documents cited in the European search report are attached.

☑ Additional set(s) of copies of the documents cited in the European search report is (are) enclosed as well.

The following specifications given by the applicant have been approved by the Search Division :

☑ Abstract ☑ Title

☐ The abstract was modified by the Search Division and the definitive text is attached to this communication.

The following figure will be published together with the abstract : 3

Refund of search fee

If applicable under Article 10 Rules relating to fees, a separate communication from the Receiving Section on the refund of the search fee will be sent later.

Europäisches Patentamt · European Patent Office · Office européen des brevets